

## CLAIMS

What is claimed is:

1 1. A method for rule-based network management, the method comprising the computer-  
2 implemented steps of:

3 defining and storing a set of rules in one or more Rule-Based Markup Language

4 (“RBML”) documents, wherein the one or more RBML documents include

5 one or more tags defining one or more rule elements, and wherein the set of  
6 rules includes:

7 a symptom-event rule that identifies as a symptom a particular event occurring  
8 within the network; and

9 a problem-diagnosis rule that defines a problem within the network as a  
10 correlation between one or more symptoms;

11 collecting and storing symptom-related data about one or more symptoms, wherein

12 collecting and storing the symptom-related data includes monitoring the

13 network for one or more network events identified in the symptom-event rule;

14 and

15 detecting a problem within the network, wherein detecting the problem includes

16 applying the problem-diagnosis rule to the symptom-related data.

1 2. A method as recited in Claim 1, the method further comprising reviewing the set of  
2 rules to identify and resolve a conflict between two or more rules in the set.

1 3. A method as recited in Claim 1, the method further comprising storing the one or  
2 more RBML documents in a rule repository, wherein the rule repository includes one or  
3 more directories containing RBML documents.

1 4. A method as recited in Claim 1, wherein a RBML document storing the problem-  
2 diagnosis rule includes:

3 a problem-definition tag describing a problem; and

4 a correlation tag identifying the correlation between one or more symptoms, wherein  
5 the one or more symptoms are defined in one or more symptom tags that  
6 include one or more pre-defined indicators associated with the one or more  
7 symptoms.

1 5. A method as recited in Claim 4, wherein the step of detecting a problem within the  
2 network further comprises the steps of:  
3 comparing the symptom-related data to the one or more pre-defined indicators  
4 associated with a particular symptom to determine whether the particular  
5 symptom exists in the symptom-related data;  
6 repeating the step of comparing the symptom-related data for all symptoms identified  
7 in the correlation tag of the RBML document storing the problem-diagnosis  
8 rule; and  
9 only if all symptoms identified in the correlation tag exist, determining that the  
10 problem identified in the problem-definition tag is detected.

1 6. A method as recited in Claim 1, wherein a RBML document storing the symptom-  
2 event rule includes:  
3 an event tag identifying the particular event occurring on the network; and  
4 a symptom tag identifying a symptom as a generalized abstraction of the particular  
5 event.

1 7. A method as recited in Claim 6, wherein the RBML document storing the symptom-  
2 event rule further includes:  
3 a profile tag identifying a particular network device; and  
4 a command tag identifying a data-collection command, wherein the data-collection  
5 command, when executed on the particular network device, returns symptom-  
6 related data associated with the particular network device.

1 8. A method as recited in Claim 1, wherein:  
2 the set of rules further includes a problem-correction rule defining one or more  
3 corrective actions capable of correcting the problem within the network; and  
4 the method further comprises the step of recommending to a user one or more  
5 corrective actions defined in a RBML document storing the problem-  
6 correction rule.

1 9. A method as recited in Claim 8, the method further comprising the step of applying to  
2 a network device, without user intervention, one or more corrective actions defined in the  
3 problem-correction rule.

1 10. A method as recited in Claim 1, wherein:  
2 the network is a first network in a plurality of networks; and  
3 the method further comprises the steps of:  
4 receiving a request from a user to employ a particular rule in managing a  
5 second network, separate from the first network; and  
6 distributing to a device on the second network the one or more RBML  
7 documents storing the particular rule.

1 11. A method for defining a Rule-Based Markup Language ("RBML") to describe a set  
2 of rules for managing a network, the method comprising the computer-implemented steps of:  
3 creating one or more RBML documents for storing the set of rules, wherein the one or  
4 more RBML documents include one or more tags defining one or more rule  
5 elements, and wherein:  
6 a RBML document storing a symptom-event rule from the set of rules  
7 includes:  
8 an event tag identifying a particular event occurring on the network;  
9 and  
10 a symptom tag identifying a symptom as a generalized abstraction of  
11 the particular event; and

12 a RBML document storing a problem-diagnosis rule from the set of rules  
13 includes:  
14 a problem-definition tag describing a problem; and  
15 a correlation tag identifying a correlation between one or more  
16 symptoms, wherein the one or more symptoms are defined in  
17 one or more symptom tags that include one or more pre-  
18 defined indicators associated with the one or more symptoms;  
19 and  
20 generating, from information stored in one or more tags of the one or more RBML  
21 documents, one or more sequences of instructions, which instructions, when  
22 executed by one or more processors, cause the one or more processors to carry  
23 out the steps of:  
24 collecting and storing symptom-related data about one or more symptoms,  
25 wherein collecting and storing the symptom-related data includes  
26 monitoring the network for one or more network events identified in  
27 the symptom-event rule; and  
28 detecting a problem within the network, wherein detecting the problem  
29 includes applying the problem-diagnosis rule to the symptom-related  
30 data.

1 12. A method as recited in Claim 11, wherein the step of detecting a problem within the  
2 network further comprises the steps of:  
3 comparing the symptom-related data to the one or more pre-defined indicators  
4 associated with the one or more symptoms to determine whether a particular  
5 symptom exists in the symptom-related data;  
6 repeating the step of comparing the symptom-related data for all symptoms identified  
7 in the correlation tag of the RBML document storing the problem-diagnosis  
8 rule; and  
9 only if all symptoms identified in the correlation tag exist, determining that the  
10 problem identified in the problem-definition tag is detected.

- 1 13. A method as recited in Claim 11, wherein the RBML document storing the symptom-  
2 event rule further includes:  
3 a profile tag identifying a particular network device; and  
4 a command tag identifying a data-collection command, wherein the data-collection  
5 command, when executed on the particular network device, returns symptom-  
6 related data associated with the particular network device.
- 1 14. A method as recited in Claim 11, wherein:  
2 the step of creating one or more RBML documents further includes creating a RBML  
3 document for storing a problem-correction rule defining one or more  
4 corrective actions capable of correcting the problem within the network; and  
5 the step of generating instructions includes generating one or more sequences of  
6 instructions, which instructions, when executed by the one or more  
7 processors, cause the one or more processors to carry out the step of  
8 recommending to a user the one or more corrective actions defined in the  
9 RBML document storing the problem-correction rule.
- 1 15. An apparatus for rule-based network management, comprising: 27  
2 a rule editor for creating and storing, in one or more Rule-Based Markup Language  
3 (“RBML”) documents containing one or more tags, a set of rules employed in  
4 managing the network, wherein the set of rules includes:  
5 a symptom-event rule that identifies as a symptom a particular event occurring  
6 within the network; and  
7 a problem-diagnosis rule that defines a problem within the network as a  
8 correlation between one or more symptoms;  
9 one or more processors;  
10 a diagnosis engine including one or more stored sequences of instructions which,  
11 when executed by the one or more processors, cause the one or more  
12 processors to carry out the steps of:

13                   collecting and storing symptom-related data about one or more symptoms,  
14                   wherein collecting and storing the symptom-related data includes  
15                   monitoring the network for one or more network events identified in  
16                   the symptom-event rule; and  
17                   detecting a problem within the network, wherein detecting the problem  
18                   includes applying the problem-diagnosis rule to the symptom-related  
19                   data.

1   16.    An apparatus as recited in Claim 15, wherein the rule editor is capable of providing to  
2   a user means for reviewing the set of rules to identify and resolve a conflict between two or  
3   more rules in the set.

1   17.    An apparatus as recited in Claim 15, wherein:  
2           the problem-diagnosis rule defining the correlation between one or more symptoms  
3           includes one or more pre-defined indicators associated with the one or more  
4           symptoms; and  
5           the diagnosis engine instructions for carrying out the step of detecting a problem  
6           within the network further include instructions for carrying out the steps of:  
7           comparing the symptom-related data to the one or more pre-defined indicators  
8           associated with the one or more symptoms to determine whether a  
9           particular symptom exists in the symptom-related data;  
10          repeating the step of comparing the symptom-related data for all symptoms  
11          identified in the problem-diagnosis rule; and  
12          only if all correlated symptoms identified in the problem-diagnosis rule exist,  
13          determining that the problem defined in the problem-diagnosis rule is  
14          detected.

1   18.    An apparatus as recited in Claim 15, wherein the symptom-event rule further  
2   includes:  
3          information identifying a particular network device; and

4 a data-collection command, wherein the data-collection command, when executed on  
5 the particular network device, returns symptom-related data associated with  
6 the particular network device.

1 19. An apparatus as recited in Claim 15, wherein:  
2 the set of rules further includes a problem-correction rule defining one or more  
3 corrective actions capable of correcting the problem within the network; and  
4 the diagnosis engine further includes instructions which, when executed by the one or  
5 more processors, cause the one or more processors to carry out the step of  
6 recommending to a user one or more corrective actions defined in the  
7 problem-correction rule.

1 20. An apparatus as recited in Claim 19, wherein the diagnosis engine further includes  
2 instructions which, when executed by the one or more processors, cause the one or more  
3 processors to carry out the step of applying to a network device, without user intervention,  
4 one or more corrective actions defined in the problem-correction rule.

1 21. An apparatus as recited in Claim 19, wherein:  
2 the network is a first network in a plurality of networks; and  
3 the apparatus further includes a rule broker, wherein the rule broker receives a request  
4 from a user to apply a particular rule in managing a second network, separate  
5 from the first network, and distributes to a device on the second network the  
6 one or more RBML documents storing the particular rule.

1 22. A computer-readable medium carrying one or more sequences of instructions for  
2 rule-based network management, which instructions, when executed by one or more  
3 processors, cause the one or more processors to carry out the steps of:  
4 defining and storing a set of rules in one or more Rule-Based Markup Language  
5 ("RBML") documents, wherein the one or more RBML documents include  
6 one or more tags defining one or more rule elements, and wherein the set of  
7 rules includes:

8           a symptom-event rule that identifies as a symptom a particular event occurring  
9           within the network; and  
10          a problem-diagnosis rule that defines a problem within the network as a  
11          correlation between one or more symptoms;  
12          collecting and storing symptom-related data about one or more symptoms, wherein  
13          collecting and storing the symptom-related data includes monitoring the  
14          network for one or more network events identified in the symptom-event rule;  
15          and  
16          detecting a problem within the network, wherein detecting the problem includes  
17          applying the problem-diagnosis rule to the symptom-related data.

1   23.    A computer-readable medium as recited in Claim 22, further comprising instructions  
2   which, when executed by the one or more processors, cause the one or more processors to  
3   carry out the step of reviewing the set of rules to identify and resolve a conflict between two  
4   or more rules in the set.

1   24.    A computer-readable medium as recited in Claim 22, further comprising instructions  
2   which, when executed by the one or more processors, cause the one or more processors to  
3   carry out the step of storing the one or more RBML documents in a rule repository, wherein  
4   the rule repository includes one or more directories containing RBML documents.

1   25.    A computer-readable medium as recited in Claim 22, wherein a RBML document  
2   storing the problem-diagnosis rule includes:  
3          a problem-definition tag describing a problem; and  
4          a correlation tag identifying the correlation between one or more symptoms, wherein  
5          the one or more symptoms are defined in one or more symptom tags that  
6          include one or more pre-defined indicators associated with the one or more  
7          symptoms.



1 26. A computer-readable medium as recited in Claim 25, further comprising instructions  
2 which, when executed by the one or more processors, cause the one or more processors to  
3 carry out the steps of:  
4 comparing the symptom-related data to the one or more pre-defined indicators  
5 associated with a particular symptom to determine whether the particular  
6 symptom exists in the symptom-related data;  
7 repeating the step of comparing the symptom-related data for all symptoms identified  
8 in the correlation tag of the RBML document storing the problem-diagnosis  
9 rule; and  
10 only if all symptoms identified in the correlation tag exist, determining that the  
11 problem identified in the problem-definition tag is detected.

1 27. A computer-readable medium as recited in Claim 22, wherein a RBML document  
2 storing the symptom-event rule includes:  
3 an event tag identifying the particular event occurring on the network; and  
4 a symptom tag identifying a symptom as a generalized abstraction of the particular  
5 event.

1 28. A computer-readable medium as recited in Claim 27, wherein the RBML document  
2 storing the symptom-event rule further includes:  
3 a profile tag identifying a particular network device; and  
4 a command tag identifying a data-collection command, wherein the data-collection  
5 command, when executed on the particular network device, returns symptom-  
6 related data associated with the particular network device.

1 29. A computer-readable medium as recited in Claim 22, wherein:  
2 the set of rules further includes a problem-correction rule defining one or more  
3 corrective actions capable of correcting the problem within the network; and

4 the computer-readable medium further comprises instructions which, when executed  
5 by the one or more processors, cause the one or more processors to carry out  
6 the step of recommending to a user one or more corrective actions defined in a  
7 RBML document storing the problem-correction rule.

1 30. A computer-readable medium as recited in Claim 29, further comprising instructions  
2 which, when executed by the one or more processors, cause the one or more processors to  
3 carry out the step of applying to a network device, without user intervention, one or more  
4 corrective actions defined in the problem-correction rule.

1 31. A computer-readable medium as recited in Claim 22, wherein:  
2 the network is a first network in a plurality of networks; and  
3 the computer-readable medium further comprises instructions which, when executed  
4 by the one or more processors, cause the one or more processors to carry out  
5 the steps of:  
6 receiving a request from a user to employ a particular rule in managing a  
7 second network, separate from the first network; and  
8 distributing to a device on the second network the one or more RBML  
9 documents storing the particular rule.

1 32. A computer-readable medium carrying one or more sequences of instructions for  
2 defining a Rule-Based Markup Language ("RBML") to describe a set of rules for managing a  
3 network, which instructions, when executed by one or more processors, cause the one or  
4 more processors to carry out the steps of:  
5 creating one or more RBML documents for storing the set of rules, wherein the one or  
6 more RBML documents include one or more tags defining one or more rule  
7 elements, and wherein:  
8 a RBML document storing a symptom-event rule from the set of rules  
9 includes:  
10 an event tag identifying a particular event occurring on the network;  
11 and

12 a symptom tag identifying a symptom as a generalized abstraction of  
13 the particular event; and  
14 a RBML document storing a problem-diagnosis rule from the set of rules  
15 includes:  
16 a problem-definition tag describing a problem; and  
17 a correlation tag identifying a correlation between one or more  
18 symptoms, wherein the one or more symptoms are defined in  
19 one or more symptom tags that include one or more pre-  
20 defined indicators associated with the one or more symptoms;  
21 and  
22 generating, from information stored in one or more tags of the one or more RBML  
23 documents, one or more sequences of instructions, which instructions, when  
24 executed by one or more processors, cause the one or more processors to carry  
25 out the steps of:  
26 collecting and storing symptom-related data about one or more symptoms,  
27 wherein collecting and storing the symptom-related data includes  
28 monitoring the network for one or more network events identified in  
29 the symptom-event rule; and  
30 detecting a problem within the network, wherein detecting the problem  
31 includes applying the problem-diagnosis rule to the symptom-related  
32 data.

1 33. A computer-readable medium as recited in Claim 32, wherein the instructions for  
2 detecting a problem within the network further comprise instructions for carrying out the  
3 steps of:  
4 comparing the symptom-related data to the one or more pre-defined indicators  
5 associated with the one or more symptoms to determine whether a particular  
6 symptom exists in the symptom-related data;  
7 repeating the step of comparing the symptom-related data for all symptoms identified  
8 in the correlation tag of the RBML document storing the problem-diagnosis  
9 rule; and

10           only if all symptoms identified in the correlation tag exist, determining that the  
11           problem identified in the problem-definition tag is detected.

1    34.    A computer-readable medium as recited in Claim 32, wherein the RBML document  
2    storing the symptom-event rule further includes:  
3           a profile tag identifying a particular network device; and  
4           a command tag identifying a data-collection command, wherein the data-collection  
5           command, when executed on the particular network device, returns symptom-  
6           related data associated with the particular network device.

1    35.    A computer-readable medium as recited in Claim 32, wherein:  
2    the instructions for creating one or more RBML documents further comprise  
3           instructions for carrying out the step of creating a RBML document for storing  
4           a problem-correction rule defining one or more corrective actions capable of  
5           correcting the problem within the network; and  
6    the instructions for generating one or more sequences of instructions, by using  
7           information stored in one or more tags of one or more RBML documents,  
8           further comprise instructions for carrying out the step of recommending to a  
9           user the one or more corrective actions defined in the RBML document  
10          storing the problem-correction rule.